WATER SUPPLIES DEPARTMENT

STANDARD SPECIFICATION M-01-05

MULTISTAGE CENTRIFUGAL PUMP AND ASSOCIATED EQUIPMENT

Revision Date : 24 January 2024

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1. DESIGN

This specification covers multistage centrifugal pump for

a) Fresh water application with driving motor output power not exceeding 40 kW; and

b) Chlorinator water supply booster pumps.

The operating speed of the pump shall not exceed 3,000 r.p.m. unless otherwise specified in the Particular Specification.

The pump shall be of robust construction with all rotating parts carefully balanced to prevent undue vibration. The pumpset shall be designed for installation in horizontal or vertical position as specified in the Particular Specification. General descriptions of pump of these two designs are set out in Clause 3 and 4 of this Standard Specification respectively. For both of the installation arrangements, no thrust load shall be transmitted to the driving motor.

Unless otherwise specified in the Particular Specification, the pump shall be supplied with its driving motor. Other necessary accessories, including pressure gauges, coupling, safety guards for rotating parts, mounting bracket or bedplate together with foundation bolts shall be provided. The pump shall be suitable for starting with delivery valve fully opened and reflux valve fully closed.

2. DUTIES AND CHARACTERISTICS

The pump shall have stable characteristics and shall be capable for continuous operation at any flow rate over the specified operating range. The operating range together with the duty flow rate and head of the pump shall be as specified in the Particular Specification.

For calculating the available net positive suction head (NPSH) at the pump for any operating condition, the minimum atmospheric pressure shall be taken as 10 m head of water and the maximum vapour pressure of water as 0.3 m head of water. The curve of NPSH required by the pump shall be submitted for assessment after award of contract.

For the water booster pump for chlorine gas ejector(s), the pump supplied shall satisfy the following requirements in determination of the pump operating range and duty point:

(a) Pump duty flow – the pump duty flow shall be able to meet the flow requirement

of the chlorine gas ejectors for creation of the required vacuum capable of drawing the specified amount of chlorine into the motive water. In assessing the pump duty flow, a 20% flow margin shall be added to cater for pump deterioration.

(b) Pump duty head – the pump duty head shall be able to overcome all head losses associated with the pipes, valves, fittings and ejector(s) for the flow requirement as specified in (a) above plus the requirement for injection of the chlorinated solution into the pump delivery pipe or dosing point(s) as specified in the Particular Specification. In assessing the pump duty head, an additional allowance equivalent to 20% of the total losses of the ejector, valves, pipes and fittings shall be added.

(c) Pump operating range – the pump operating range for flow rate and head shall be able to meet all the possible operating conditions of the chlorine gas ejectors and the required injection pressure range as specified in the Particular Specification.

(d) The rating for the motor if required to be provided for the booster pumps shall be not less than 120% of the maximum power absorbed by the pump over the whole operating range specified.

3. HORIZONTAL PUMPSET

The pump assembly and the driving motor shall be mounted horizontally on a common bedplate and shall be properly aligned and coupled through a suitable coupling. The bedplate shall be of robust construction so that no excessive vibration shall be induced during operation of the pump. Suitable cable access shall be provided on the bedplate to the motor cable box.

4. VERTICAL PUMPSET

The pump shall be vertically mounted with a flange type driving motor mounted onto the motor stool. The motor shall be properly aligned and coupled to the pump shaft through a suitable coupling. The pump shall be properly designed so that no excessive vibration shall be induced during the operation of the pump.

5. PUMP TESTS

All pump components subject to pressure shall be hydraulically tested to a pressure of not less than 150% of the maximum operating pressure of the pump. The maximum operating pressure of the pump must be at least the sum of the maximum suction head plus the zero flow head of the pump supplied. The test shall be sustained for a period of not less than 10 minutes, so as to provide a safety margin against possible surge pressure.

On completion of assembly at the Manufacturer’s works, the pump shall be coupled with its driving motor or if not to a slave motor supplied, and tested to BS EN ISO

9906 over the full range of its capabilities to determine pump output, power absorbed and efficiency. For pump with shaft input power in excess of 10 kW, the tests shall be carried out in the presence of a representative of an Independent Inspection Body (IIB) unless otherwise stated in the Particular Specification.

Noise measurement shall be made on the pumpset with its own motor or a slave motor coupled up at the Manufacturer's works at closed valve head. The limiting sound pressure level for the pumpset shall not exceed 94 dBA at any point 1 m from the pumpset. Noise measurement shall be conducted in accordance with BS EN ISO 1680.

The tolerance factors to be applied to pump test at the duty flow and head conditions and the corresponding pump efficiency shall comply with the following requirements:

Testing Parameters	**Shaft Input Power of the Pump**	
	≤ 10 kW	**> 10 kW**
Flow rate, head and pump efficiency	According to Clause 4.4.2 of BS EN ISO 9906	According to Grade 2B in Clause 4.4.1 of BS EN ISO 9906
Witnessed test requirements	Pump type test certificate in lieu of works test certificate issued by an Independent Inspection Body (IIB) shall also be acceptable provided the Contractor / *Contractor* (hereafter referred to as the Contractor) can guarantee that the performance of the pump shall not be inferior to that indicated in the type test certificate, and the pump components have undergone pressure test of not less than 150% of the maximum operating pressure of the pump. If noise level of pump is not indicated in the type test certificate or no other relevant document can be produced by the pump manufacturer to substantiate its compliance with the requirement as set out in this Clause, the pump shall be subject to noise level measurement at site after its installation. All costs associated with the measurements, and all necessary measures to limit the pump noise to the acceptable level, if	Pump test, including noise level test as required under this Clause, shall be carried out in the presence of a representative of an Independent Inspection Body (IIB) unless otherwise stated in the Particular Specification

Testing Parameters	Shaft Input Power of the Pump	
	≤ 10 kW	**> 10 kW**
	required, shall be borne by the Contractor.	

The Contractor shall carry out the site tests in accordance with the site test forms attached in the Appendix. For proposed changes to the site test forms or other site tests which are not included in the Appendix, the Contractor shall submit the test forms and procedures to the Engineer / the *Project Manager* for approval prior to carrying out the tests.

6. MATERIALS OF CONSTRUCTION

The pump shall be manufactured from the following materials or other equivalent or superior suitable materials:-

Components	Material Specification
Pump casing, including suction, discharge, stage casings and diffusers (Optional item) with internal wetted surface	Stainless Steel to BS EN 10088 Designation 1.4401 / BS EN 10283 Designation 1.4408 Or High Quality Grey Cast Iron to BS EN 1561 EN-GJL-250 with internal coating suitable for fresh water application in compliance with BS 6920 or equivalent. The application of such coating must be in compliance with the instructions given by the coating manufacturer.
Motor stool (Optional item) and bedplate	High Quality Grey Cast Iron to BS EN 1561 EN-GJL-250
Impellers	Stainless Steel to BS EN 10088 Designation 1.4401 / BS EN 10283 Designation 1.4408
Wear Rings	Lead-free alloy or other materials of suitable grades
Pump Shaft	Stainless Steel to BS EN 10088 Designation 1.4021 / 1.4401 / 1.4057
Shaft Sleeves (Optional item)	Stainless Steel to BS EN 10088 Designation 1.4021 / 1.4401

7. PUMP CASING

Unless otherwise specified in the Particular Specification, the pump casing shall be fitted with replaceable wear rings. Except for in-line vertical pump, radially drilled and tapped bosses adjacent to the respective suction and delivery flanges of the pump shall be provided for installation of pressure gauges. Air release cocks, which shall be fitted at the highest point of the first and last stage chambers, and drain valve shall be provided for the

pump.

8. PUMP IMPELLERS

The impellers shall be designed with sufficient strength at the boss to withstand all possible stresses imposed by the drive. The impellers shall be machined to close limits inside the pump casing and dynamically balanced.

9. PUMP SHAFT AND SHAFT SEAL

The pump shaft shall be protected from wear by replaceable sleeves as appropriate. The pump shall be fitted with mechanical seals suitable for use with a pressure greater than the sum of the maximum suction head plus the zero flow head.

10. BEARINGS

Ball and roller type bearings shall be sealed, grease lubricated and protected from the ingress of dust and water. These bearings shall conform to the relevant BS, BS EN, ISO or other equivalent standards and shall be readily obtainable in the market. Special bearings and Imperial bearings are not acceptable.

11. PRESSURE GAUGES

Bourdon tube type suction and delivery pressure gauges of suitable range and graduated in both kPa and metres head of water shall be provided.

The pressure gauges shall be in compliance with Water Supplies Department (WSD) Standard Specification EM-01-03.

The gauge complete with isolating cock shall be mounted at the tappings adjacent to the pump suction and delivery flanges.

An additional tee connection, with a separate isolating cock shall be provided between the gauge and pump branch for connection of portable instruments.

If vertical in-line multistage pump is specified in the Particular Specification, the aforesaid suction and delivery pressure gauges and the associated isolation cock shall be supplied with the pump as loose items.

12. MOTOR

Unless otherwise specified in the Particular Specification, the motor, if it is to be supplied with the pump, shall be in compliance with WSD Standard Specification

E-51-04 for Squirrel Cage Induction Motors below 40 kW or WSD Standard Specification E-51-03 for Squirrel Cage Induction Motors of 40 – 140 kW.

13. INFORMATION TO BE PROVIDED IN THE PARTICULAR SPECIFICATION

The following information shall be provided in the Particular Specification.

Clause in this Standard Specification	Requirement to be specified in the Particular Specification.
Clause 1 Design	To specify whether the pumpset shall be horizontally or vertically mounted. For vertically mounted design, to specify whether in-line vertical multistage pump (i.e. suction and delivery are at same level) shall be supplied.
Clause 2 Duties and Characteristics	The operating range together with the duty flow rate and head of the pump.

The following information, if specified in the Particular Specification, shall take precedence over the respective requirements stated in this Standard Specification.

Clause in this Standard Specification	Alternative requirements that can be specified in the Particular Specification.
Clause 1 Design	The operating speed of the pumpset in excess of 3,000 r.p.m.
	The driving motor shall be provided by WSD.
	The components to be supplied with the pumpset.
Clause 5 Pump Tests	Waiving of the requirement to have the pumpset tested in the presence of a representative of an Independent Inspection Body (IIB).
Clause 7 Pump Casing	Waiving of the requirement to have replaceable wear rings fitted in the pump casing.

The following information can be specified in the Particular Specification as optional requirement, particularly in vibration or sound sensitive area.

Clause in this Standard Specification	Optional requirements that can be specified in the Particular Specification.
Clause 3 Horizontal Pumpset or Clause 4 Vertical Pumpset	Addition of suction and discharge flexible pipe / expansion bellow, and vibration isolators, for example inertia block with metal springs or isolation pads at pump base, for reduction of adverse effect caused by vibration.

14. INFORMATION REQUIRED IN THE MATERIAL SUBMISSION BY THE CONTRACTOR

The following information shall be provided in the material submission for material approval / *acceptance* by the Engineer or the *Project Manager*.

Item	Description	Details
1	Technical Schedule	Manufacturer
		Country of origin
		Model / Type
		Flow capacity at duty point(s)
		Total head at duty point(s)
		Efficiency at duty point(s)
		NPSH at duty point(s)
		Speed
		Materials and coatings
		Suction and discharge flange sizes and standard
2	Compliance with Standard Specification M-01-05	
3	Compliance with Particular Specification	
4	Pump Catalogue	Outline and sectional drawing of the pump, indicating the general dimensions, components and materials
		Pump performance curves, indicating the flow capacity, total head, efficiency, NPSH and the duty point(s)
5	Certificates	Certificate of origin
		Water Regulations Approval Scheme (WRAS) certificate
		Type test certificate indicating the guaranteed performance in flow capacity, total head, efficiency, noise level and pressure test (for pump with shaft input power $\leq$ 10 kW)

- End of Specification -

Appendix

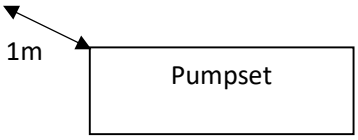
Standard Site Test Forms

WSD M-01-05 Site Test Form 1
Noise Level of Pumpset

Contract no.: _____
Contract title: _____

Contractor: _____ Shaft Input Power: ≤ 10 kW or > 10 kW
Location: _____ Pump Model: _____
Pumpset no.: _____ Serial No.: _____
Manufacturer: _____ Motor Model: _____
Date: _____ Serial No.: _____

1. Background: dBA



2. Background: dBA

3. Background: dBA

4. Background: dBA

Measurement	Location (dBA)				Flow	Head	Speed	Note
	1	2	3	4	l/s	m	rpm	
1								
2								
3								
4								

Acceptance criteria: ≤ 94 dBA at any point 1 m from the pumpset

Test	Manufacturer	Model	Serial No.	Calibration	Expiry
1					
2					

Remarks: _____

Tested by: _____ Date: _____
(Signature) (Name in block letter)

Witnessed by: _____ Date: _____
(Signature) (Name in block letter)

Witnessed by: _____ Date: _____
(Signature) (Name in block letter)

WSD M-01-05 Site Test Form 2
Performance Test of Pumpset

Contract no.: _____
Contract title: _____

_____

Contractor: _____ Shaft Input Power: ≤ 10 kW or > 10 kW
Location: _____ Pump Model: _____
Pumpset no.: _____ Serial No.: _____
Manufacturer: _____ Motor Model: _____
Date: _____ Serial No.: _____

Starting current: _____ (A) Starting time: _____ (sec)

Suction
Level of pressure gauge: (z1)_____ (m) above pipe centre
Pipe diameter: _____ (m)
Pipe internal area: _____ (m2)

Discharge
Level of pressure gauge: (z2)_____ (m) above pipe centre
Pipe diameter: _____ (m)
Pipe internal area: _____ (m2)

Time	Suction head (corrected to pipe centre) Ps		Discharge head (corrected to pipe centre) Pd		Velocity head	Total head H	Flow rate Q	Shaft power P	Pump efficiency	Current	Voltage	Motor input power W	Motor efficiency	Overall efficiency
	Valve opening %	(m)	Valve opening %	(m)	(m)	(m)	(m3/h)	(W)	(%)	(A)	(V)	(W)	(%)	(%)

WSD M-01-05 Site Test Form 2
Performance Test of Pumpset

Time	Speed	Results from Yatesmeter			
		Total head H	Flow rate Q	Shaft power P	Pump efficiency
	(rpm)	(m)	(m3/h)	(W)	(%)

Pressure Test		
Maximum suction head		(m)
Zero flow head		(m)
150% of maximum operating pressure		(m)
No leakage for 10 minutes	Y/N	

Test Instrument	Manufacturer	Model	Serial No.	Calibration Certificate no.	Expiry Date
1					
2					
3					
4					

Remarks: _____

Tested by: _____ Date: _____
(Signature) (Name in block letter)

Witnessed by: _____ Date: _____
(Signature) (Name in block letter)

Witnessed by: _____ Date: _____
(Signature) (Name in block letter)

WSD M-01-05 Site Test Form 3
Endurance Test of Pumpset

Contract no.: _____
Contract title: _____

_____

Contractor: _____ Shaft Input Power: ≤ 10 kW or > 10 kW
Location: _____ Pump Model: _____
Pumpset no.: _____ Serial No.: _____
Manufacturer: _____ Motor Model: _____
Date: _____ Serial No.: _____

Time	Suction pressure	Discharge pressure	Flow rate	Current	Voltage	Input power	Temperature							Speed
							Pump		Motor		Winding			
	(m)	(m)	(m3/h)	(A)	(V)	(W)	DE brg.	NDE brg.	DE brg.	NDE brg.	U1	V1	W1	(rpm)

Reading interval: 0 - 3 hrs. (30 min.), 3-24 hrs. (60 min.)